SOIL AND WATER QUALITY MONITORING IN OPENCAST MINES

A THESIS SUBMITTED IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

BACHELOR OF TECHNOLOGY

IN

MINING ENGINEERING

BY

ANIRUDHA SISODIA

109MN0650

Department of Mining Engineering
National Institute of Technology
Rourkela – 769008, India

SOIL AND WATER QUALITY MONITORING IN OPENCAST MINES

A THESIS SUBMITTED IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

BACHELOR OF TECHNOLOGY

IN

MINING ENGINEERING

BY

ANIRUDHA SISODIA

109MN0650

Under the Guidance of

Prof. D. P. Tripathy & Prof. S. Jayanthu

Department of Mining Engineering
National Institute of Technology
Rourkela – 769008, India

National Institute of Technology

Rourkela

CERTIFICATE

This is to certify that the thesis entitled "**Soil and Water Quality Monitoring in Opencast Mines**" submitted by Sri Anirudha Sisodia, Roll No**.** 109MN0650 in partial fulfillment of the requirements for the award of Bachelor of Technology degree in Mining Engineering at the National Institute of Technology, Rourkela (Deemed University) is an authentic work carried out by him under our supervision and guidance.

To the best of our knowledge, the matter embodied in the thesis has not been submitted to any other University/ Institute for the award of any Degree of Diploma**.**

Prof. D.P. TRIPATHY
Professor
Dept. of Mining Engineering
National Institute of Technology
Rourkela-769008

Prof. S. JAYANTHU
Professor
Dept. of Mining Engineering
National Institute of Technology
Rourkela-769008

ACKNOWLEDGEMENT

I am indebtedness to **Dr. Debi Prasad Tripathy** Professor of Department of Mining Engineering and **Prof. S. Jayanthu** Professor of Department of Mining Engineering for allowing me to carry on the project topic "Soil and Water Quality Monitoring in Opencast Mines". I express my gratitude towards their inspiring direction, valuable suggestions and remarkable explanation throughout this project work. I thank them for their able guidance and pain taking effort in improving my understanding of this project.

I extend my veneration towards those whose details are mentioned in the reference section. I acknowledge my indebtedness to all of them.

At last, I feel privileged to have such a friend circle who patiently extended all sorts of help for successfully accomplishing this project.

Date:

Anirudha Sisodia
109MN0650

Abstract

The opencast mining deteriorates the environment in numerous ways. One of the aspects of environment, it harms the most to the Soil and Water. Thus, estimation of quality of Soil and Water is extremely important for proper assessment of the associated hazards. Due to the lack of proper planning and negligence of regulations, an appreciable amount of environmental degradation and ecological damage to Soil and Water occurs.

The soil samples are collected from the Bolani Iron Ore Mines. 8 samples of soil are collected and analysed for the parameters like pH (5-6.5 acidic in nature), organic carbon, soil nitrogen (0-280 kg/ha which is low quantity), calcium, magnesium, potassium and sulphur (22.4-44.8 kg/ha.) of soil.

The water samples are collected from Bisra stone lime mine and analyzed for various physical, chemical, metallic and organic parameters were found which included determination of turbidity (23-32 NTU), conductivity, solids, iron, chromium content, pH, hardness (154-159 mg/L, mild hard), ammonia, nitrate, sulphate, phenol, fluoride, phosphate and organic parameters of importance such as Dissolved oxygen, Bio-chemical Oxygen Demand and Chemical Oxygen Demand.

Hence all the parameters of soil and water are compared, the soil is more polluted than water. So for control the soil and water pollution it is suggested that appropriate steps must be taken by the industry, State Pollution Control Board and the Government to prevent pollution of soil and water. Implementation of preventive measures proposed can be helpful to a great extent.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER: 1

INTRODUCTION

CHAPTER: 1

INTRODUCTION

The opencast mining deteriorates the environment in numerous ways. One of the aspects of environment, it harms the most to the Soil and Water. Thus, estimation of quality of Soil and Water is extremely important for proper assessment of the associated hazards. Due to the lack of proper planning and negligence of regulations, an appreciable amount of environmental degradation and ecological damage to Soil and Water occurs.

Soil quality monitoring is important because the opencast mining operations routinely modify the surrounding landscape by exposing previously undisturbed earthen materials. Erosion of exposed soils, extracted mineral ores, tailings, and fine material in waste rock piles can result in substantial sediment loading to surface waters and drainage ways. In addition, spills and leaks of hazardous materials and the deposition of contaminated windblown dust can lead to soil contamination.

Perhaps the most significant impact of a mining project is its effects on water quality and availability of water resources within the project area. Key questions are whether surface and groundwater supplies will remain fit for human consumption, and whether the quality of surface waters in the project area will remain adequate to support native aquatic life and terrestrial wildlife.

It is therefore essential to carry out soil and water quality studies and its fitness for various applications; otherwise its use may lead to disastrous consequences in the long run. Keeping this in view, this project work was undertaken to carry out soil and water quality monitoring in open cast mines.

1.1 Objectives of the Project

- To assess the topsoil and dumpsoil quality of Bolani Iron Ores Ltd.
- To assess the water quality of abandoned and working quarry of Bisra Stone Lime Ltd.
- Compare the analyzed characteristics of Soil and Water with Indian Standards.

CHAPTER: 2

LITERATURE REVIEW

CHAPTER: 2

LITERATURE REVIEW

2.1 IMPACT OF MINING ON ENVIRONMENT

Day by day as the mining activity increases it gives a huge impact on our environment. The impact of mining is on all the natural resources which can possess the effect on human as well as on wild life. The effect of mining activities are on soil, water, air, wild life, social values, and on climate conditions.

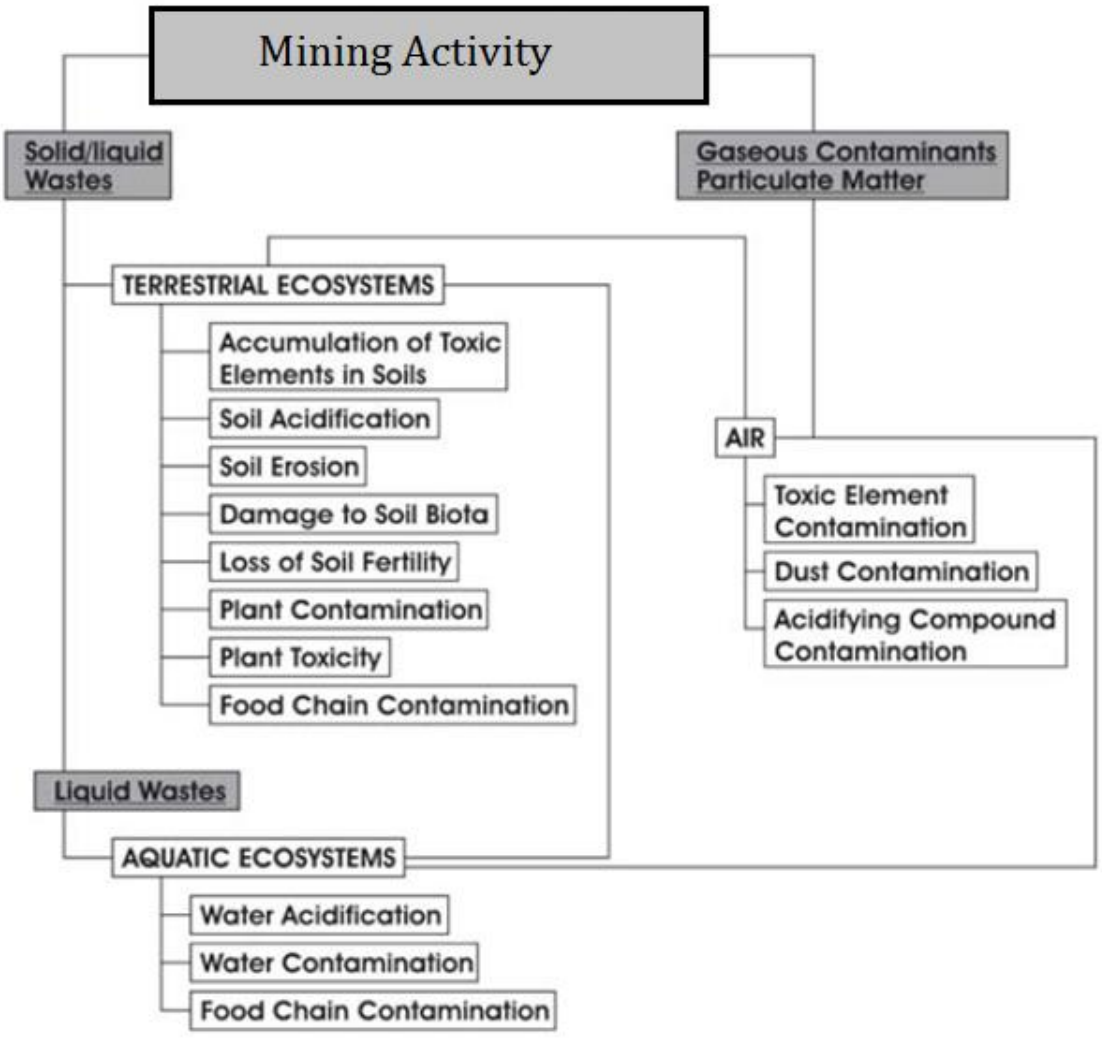

Fig 2.1 Environmental impacts of mining

2.1.1 Impact of Coal Mining on Environment

The environmental impact of the coal industry includes the consideration of issues such as land use, waste management, and water and air pollution caused by the coal mining, processing and the use of its products. In addition to atmospheric pollution, coal burning produces hundreds of millions of tons of solid waste products annually, including fly ash, bottom ash, and flue-gas desulfurization sludge that contain mercury, uranium, thorium, arsenic, and other heavy metals.

There are severe health effects caused by burning coal. According to the reports issued by the World Health Organization in 2008 and by environmental groups in 2004, coal particulates pollution are estimated to shorten approximately 1,000,000 lives annually worldwide, including nearly 24,000 lives a year in the United States. Coal mining generates significant additional independent adverse environmental health impacts, among them the polluted water flowing from mountaintop removal mining.

Impact of Coal Mining on Soil

Strip mining severely alters the landscape, which reduces the value of the natural environment in the surrounding land. The land surface is dedicated to mining activities until it can be reshaped and reclaimed. If mining is allowed, resident human populations must be resettled off the mine site; economic activities, such as agriculture or hunting and gathering food and medicinal plants are interrupted. What becomes of the land surface after mining is determined by the manner in which the mining is conducted. Usually reclamation of disturbed lands to a land use condition is not equal to the original use. Existing land uses (such as livestock grazing, crop and timber production) are temporarily eliminated from the mining area. High-value, intensive-land-use areas like urban and transportation systems are not usually affected by mining operations. If mineral values are sufficient, these improvements may be removed to an adjacent area.

Strip mining eliminates existing vegetation, destroys the genetic soil profile, displaces or destroys wildlife and habitat, alters current land uses, and to some extent permanently changes the general topography of the area mined. Adverse impacts on geological features of human interest may occur in a coal strip mine. Geomorphic and geophysical features and outstanding scenic resources may be sacrificed by indiscriminate mining. Paleontological, cultural, and other historic values may be endangered due to the disruptive activities of blasting, ripping, and

excavating coal. Stripping of overburden eliminates and destroys archeological and historic features, unless they are removed beforehand.

The removal of vegetative cover and activities associated with the construction of haul roads, stockpiling of topsoil, displacement of overburden and hauling of soil and coal increase the quantity of dust around mining operations. Dust degrades air quality in the immediate area, has an adverse impact on vegetative life, and constitutes health and safety hazards for mine workers and nearby residents.

Surface mining disrupts virtually all aesthetic elements of the landscape. Alteration of landforms often imposes unfamiliar and discontinuous configurations. New linear patterns appear as material is extracted and waste piles are developed. Different colors and textures are exposed as vegetative cover is removed and overburden dumped to the side. Dust, vibration, and diesel exhaust odors are created (affecting sight, sound, and smell). Residents of local communities often find such impacts disturbing or unpleasant. In case of mountaintop removal, tops are removed from mountains or hills to expose thick coal seams underneath. The soil and rock removed is deposited in nearby valleys, hollows and depressions, resulting in blocked (and contaminated) waterways.

Removal of soil and rock overburden covering the coal resource may cause burial and loss of topsoil, exposes parent material, and creates large infertile wastelands. Soil disturbance and associated compaction result in conditions conducive to erosion. Soil removal from the area to be surface-mined alters or destroys many natural soil characteristics, and reduces its biodiversity and productivity for agriculture. Soil structure may be disturbed by pulverization or aggregate breakdown.

Mine collapses (or mine subsidences) have the potential to produce major effects above ground, which are especially devastating in developed areas. German underground coal-mining (especially in North Rhine-Westphalia) has damaged thousands of houses, and the coal-mining industries have set aside large sums in funding for future subsidence damages as part of their insurance and state-subsidy schemes. In a particularly spectacular case in the German Saar region (another historical coal-mining area), a suspected mine collapse in 2008 created an earthquake measuring 4.0 on the Richter magnitude scale, causing some damage to houses. Previously, smaller earthquakes had become increasingly common and coal mining was temporarily suspended in the area.

In response to negative land effects of coal mining and the abundance of abandoned mines in the US the federal government enacted the Surface Mining Control and Reclamation Act of 1977, which requires reclamation plans for future coal mining sites. These plans must be approved by federal or state authorities before mining begins.

Impact of Coal Mining on Water

Open-pit mining requires large amounts of water for coal preparation plants and dust suppression. To meet this requirement mines acquire (and remove) surface or groundwater supplies from nearby agricultural or domestic users, which reduces the productivity of these operations or halts them. These water resources (once separated from their original environment) are rarely returned after mining, creating a permanent degradation in agricultural productivity. Underground mining has a similar (but lesser) effect, due to a lower need for dust-suppression water; however, it still requires sufficient water for coal-washing.

Groundwater supplies may be adversely affected by surface mining. These impacts include drainage of usable water from shallow aquifers; lowering of water levels in adjacent areas and changes in flow direction within aquifers; contamination of usable aquifers below mining operations due to infiltration (percolation) of poor-quality mine water; and increased infiltration of precipitation on spoil piles. Where coal (or carbonaceous shale) is present, increased infiltration may result in:

- Increased runoff of poor-quality water and erosion from spoil piles
- Recharge of poor-quality water to shallow groundwater aquifers
- Poor-quality water flow to nearby streams

This may contaminate both groundwater and nearby streams for long periods. Deterioration of stream quality results from acid mine drainage, toxic trace elements, high content of dissolved solids in mine drainage water, and increased sediment loads discharged to streams. When coal surfaces are exposed, pyrite comes in contact with water and air and forms sulfuric acid. As water drains from the mine, the acid moves into the waterways; as long as rain falls on the mine tailings the sulfuric-acid production continues, whether the mine is still operating or not. Also waste piles and coal storage piles can yield sediment to streams. Leached water from these piles can be acid and contain toxic trace elements. Surface waters may be rendered unfit for agriculture, human consumption, bathing, or other household uses.

To mitigate these problems, water is monitored at coal mines. The five principal technologies used to control water flow at mine sites are:

- Diversion systems
- Containment ponds
- Groundwater pumping systems
- Subsurface drainage systems
- Subsurface barriers

Impact of Coal Mining on Waste Management

The burning of coal leads to substantial fly ash sludge-storage ponds. In the low-coal-content areas waste forms spoil tip. The Environmental Protection Agency classified the 44 sites as potential hazards to communities (which means the waste sites could cause death and significant property damage if an event such as a storm, a terrorist attack or a structural failure caused a spill). They estimate that about 300 dry landfills and wet storage ponds are used around the country to store ash from coal-fired power plants. The storage facilities hold the noncombustible ingredients of coal and the ash trapped by equipment designed to reduce air pollution.

Impact of Coal Mining on Wildlife

Surface mining of coal causes direct and indirect damage to wildlife. The impact on wildlife stems primarily from disturbing, removing and redistributing the land surface. Some impacts are short-term, and confined to the mine site; others have far-reaching, long-term effects.

The most direct effect on wildlife is destruction or displacement of species in areas of excavation and spoil piling. Pit and spoil areas are not capable of providing food and cover for most species of wildlife. Mobile wildlife species like game animals, birds, and predators leave these areas. More sedentary animals like invertebrates, reptiles, burrowing rodents and small mammals may be destroyed. The community of microorganisms and nutrient-cycling processes are upset by movement, storage, and redistribution of soil.

Degradation of aquatic habitats is a major impact by surface mining, and may be apparent many miles from a mining site. Sediment contamination of surface water is common with surface

mining. Sediment yields may increase a thousand times times their former level as a result of strip mining.

The effects of sediment on aquatic wildlife vary with the species and the amount of contamination. High sediment levels can kill fish directly, bury spawning beds, reduce light transmission, alter temperature gradients, fill in pools, spread stream flows over wider, shallower areas, and reduce production of aquatic organisms used as food by other species. These changes destroy the habitat of valued species, and may enhance habitat for less-desirable species. Existing conditions are already marginal for some freshwater fish in the United States, and the sedimentation of their habitat may result in their extinction. The heaviest sediment pollution of a drainage normally comes within 5 to 25 years after mining. In some areas, unvegetated spoil piles continue to erode even 50 to 65 years after mining.

The presence of acid-forming materials exposed as a result of surface mining can affect wildlife by eliminating habitat and by causing direct destruction of some species. Lesser concentrations can suppress productivity, growth rate and reproduction of many aquatic species. Acids, dilute concentrations of heavy metals, and high alkalinity can cause severe damage to wildlife in some areas. The duration of acidic-waste pollution can be long; estimates of the time required to leach exposed acidic materials in the Eastern United States range from 800 to 3,000 years.

Impact of Coal Mining on Air

Coal and coal waste products (including fly ash, bottom ash and boiler slag) releases approximately 20 toxic-release chemicals, including arsenic, lead, mercury, nickel, vanadium, beryllium, cadmium, barium, chromium, copper, molybdenum, zinc, selenium and radium, which are dangerous if released into the environment. While these substances are trace impurities, enough coal is burned that significant amounts of these substances are released.

During combustion, the reaction between coal and the air produces oxides of carbon, including carbon dioxide (CO2 (an important greenhouse gas)), oxides of sulfur (mainly sulfur dioxide) (SO2), and various oxides of nitrogen (NOx). Because of the hydrogenous and nitrogenous components of coal, hydrides and nitrides of carbon and sulfur are also produced during the combustion of coal in air. These include hydrogen cyanide (HCN), sulfur nitrate (SNO3) and other toxic substances.

The wet cooling towers used in coal fired power stations, etc. emit drift and fog which are also environmental concern. The drift from the cooling towers is containing Repairable suspended particulate matter. In case of cooling towers with sea water makeup, sodium salts are deposited on nearby lands which would convert the land into alkali soil by reducing the fertility of vegetative lands and also cause corrosion of nearby structures.

Fires sometimes occur in coal beds underground. When coal beds are exposed, the fire risk is increased. Weathered coal can also increase ground temperatures if it is left on the surface. Almost all fires in solid coal are ignited by surface fires caused by people or lightning. Spontaneous combustion is caused when coal oxidizes and airflow is insufficient to dissipate heat; this more commonly occurs in stockpiles and waste piles, rarely in bedded coal underground. Where coal fires occur, there is attendant air pollution from emission of smoke and noxious fumes into the atmosphere. Coal seam fires may burn underground for decades, threatening destruction of forests, homes, roadways and other valuable infrastructure. The best-known coal-seam fire may be the one which led to the permanent evacuation of Centralia, Pennsylvania, United States.

Impact of Coal Mining on Death Rate

In 2008 the World Health Organization (WHO) and other organizations calculated that coal particulates pollution because approximately one million deaths annually across the world, which is approximately one third of all premature deaths related to all air pollution sources.

Pollutants emitted by burning coal include fine particulates (PM2.5) and ground level ozone. Every year, the burning of coal without the use of available pollution control technology causes thousands of preventable deaths in the United States. A study commissioned by the Maryland nurses association in 2006 found that emissions from just six of Maryland's coal-burning plants caused 700 deaths per year nationwide, including 100 in Maryland. Since installation of pollution abatement equipment on one of these six, the Brandon Shores plant, and now "produces 90 percent less nitrogen oxide, an ingredient of smog; 95 percent less sulfur, which causes acid rain; and vastly lower fractions of other pollutants."

According to a report published in 2004, coal-fired power plants shorten nearly 24,000 lives a year in the United States (2,800 from lung cancer). In the United States alone, the United States Environmental Protection Agency (EPA) estimates that a range of 13,000 to 34,000 preventable

premature deaths will be avoided by the reductions in PM2.5 and ozone expected by the end of the several-years' time needed to complete implementation of the coal plant cleanup provisions of the Final Cross-State Air Pollution Rule (CSAPR).

In addition to preventing avoidable premature deaths, the Final Cross-State rule is estimated to prevent 15,000 additional (non-fatal) heart attacks, 19,000 attacks of acute bronchitis; 420,000 upper and lower respiratory symptoms, 400,000 aggravated asthma attacks; and 19,000 hospital and ER trips (e.g., for asthma attacks triggered by soot from coal burning). By reducing the health detriments that arise from burning coal without using available pollution controls, implementation of the Final Cross-State Air Pollution Rule is expected to reduce days when people must miss work or school by 1.8 million.

The Cross-State Air Pollution Rule requires significant reductions in sulfur dioxide (SO2) and nitrogen oxide (NO) emissions that cross state lines. These pollutants react in the atmosphere to form fine particles and ground-level ozone and are transported long distances, making it difficult for other states to achieve healthy levels of pollution control. The benefits of the emission reductions expected from EPA's recently proposed Mercury and Air Toxics Standards (MATS) are not included in the above estimated emission reductions from the Cross-State Air Pollution Rule; once the Mercury and Air Toxics Standards are implemented, death and disease from coal burning are likely to be reduced even further, both directly by reducing mercury poisoning, and by reducing sulfur dioxide emissions.

2.1.2 Impact of Metal Mining on Environment

It is recognized that minerals and metals are the mainstay of the economic development and welfare of the society. However, their exploration, excavation and mineral processing directly infringe upon and affect the other natural resources like land, water, air, flora and fauna, which are to be conserved and optimally utilized in a sustainable manner. The mineral sector in India is on the threshold of expansion with more and more open cast iron ore mines being opened-up in the state of Jharkhand, Orissa, Karnataka and Chattisgarh. Under such scenario, systematic and scientific exploitation of iron ore, compatible with environment is essential for survival of our future generation.

Mining being site specific activity, excavation is bound to be done at a place where mineral actually exist. Hence, the mining process changes the land use of the area and is of no use to the

mining companies once mineral is exhausted completely. In the process, mining affects all the components of environment and the impacts are permanent/temporary, beneficial/harmful, repairable/irreparable, and reversible/irreversible. Mines especially open cast iron ore mines, due to its own peculiarities can cause disturbance in ecology, resulting in various pollution problems. The environmental problems are more significant in India, as most of the iron ore mines located on top of hills and in dense forest areas.

The environmental problems associated with the iron ore mining are diverse. The removal of vegetation, top soil, overburden/waste and ore, brings about the inevitable natural consequences, which manifest in many ways, deforestation, climatic change, erosion, air and water pollution and health hazards. Iron ore mining and processing of ore, affects the environment in myriad ways causing:

- Land disturbance and change in land use pattern
- Affecting floral and faunal habitat
- Disturbing the natural watershed and drainage pattern of the area
- Disturbing the aquifer causing lowering of the water table
- Air pollution due to dust and noxious fumes
- Water pollution due to surface run off from different areas of mines, spoil dumps, seepages/overflow from tailings dam leads to siltation of surface water bodies and blanketing the agricultural fields.
- Noise and ground vibrations due to blasting.
- Socio-economic impacts

The magnitude and significance of these impacts on environment and ecology due to mining will depend on the size and scale of mining activity in conjunction with the topography & climatic conditions of the area, the nature of mineral deposits, method of mining & capacity of mines, agricultural activities in the region, forest reserves etc.

Impact of Metal Mining on Soil

Mining is a temporary land use of the area. Being a site specific industry there is no choice in siting a mining project, a luxury available to most other industries. Land is required not only for the mine excavation proper and laying approach / haul roads, but also for beneficiation plant, ore

handling & dispatch units, waste dumps, tailing ponds etc. Land is also required for ancillary facilities and statutory buildings (workshops, stores, offices, canteen, and crèche). In addition to these, residential colony and related welfare amenities like school, hospital, shopping Centre, recreation Centre etc. also require land.

The major impact on the land use during the pre-mining phase is removal of vegetation and resettlement of displaced population. During mining and post-mining phases, drastic changes in landscape with landform take place. The major associated impacts are soil-erosion, loss of top soil, creation of waste dumps and voids, disposal of wastes, deforestation etc. The impacts of iron ore mining on land are as outlined hereunder;

- Topography and land scenario changes due to excavation of open pits and dumping of overburden rock mass in the form of land heaps.
- The land-use pattern undergoes a change due to the use of the land for mining, dumping, and other mining and associated activities.
- The land-use in the surrounding areas may get affected due to the impacts of mining on water regime.
- Leachates from overburden dumps and other rock masses and polluted water from the pits affect the characteristics of the top-soil affecting the land-use.
- In the mines having mineral concentration/processing plants, it is required to make tailings pond to store the tailings generated from the processing plants. These tailing ponds require massive area and may cause pollution of ground and surface water bodies, if proper care is not taken.
- The drainage pattern of the area undergoes a change due to the alterations in the surface topography due to mining and associated activities.

It is evident from the above that the mining and associated activities can significantly change the land use and drainage pattern of the region. These changes can be minimized by careful planning the surface layout of the mining areas and by integrating the environmental aspects of each and every unit operation of mining activity. Another important aspect of the land management is the planning and design of the land reclamation programme right from the inception, including the development of the post mining land use planning for optimum utilization of land in an efficient manner and for overall improvement in environmental scenario.

Impact of Metal Mining on Water

Mining and associated activities have quantitative and qualitative impacts on the water regime in and around the mines. These are briefly outlined hereunder;

- All the surface water bodies have to be removed from the area designed for the mining and associated activities.
- All the aquifers, including the water–table aquifer, above the mineral deposit to be extracted are damaged
- If there are high pressure aquifers below the mineral deposit it becomes necessary to pump the water from the aquifers to reduce the water pressure to facilitate mining
- Water in the nearby water bodies gets polluted due to leaching from the overburden dumps, discharge of pumped mine water, and other activities in the vicinity of the water bodies
- During rainy season the runoff water from the areas surrounding the mines carries with large quantity of the suspended solids into the nearby water bodies.

It is evident from the above that the mining and associated activities changes in ground water flow patterns, lowering of water table, changes in hydrodynamic conditions of river/underground recharge basins, reduction in volumes of subsurface discharge to water bodies/rivers, disruption and diversion of water courses/drainages pattern, contamination of water bodies, affecting the yield of water from bore wells and dug wells etc. Therefore, it is necessary to plan the mining and associated activities in such a manner that their impacts on the water regime are as minimum as possible.

Impact of Metal Mining on Ecology

The mining activities like excavation, transportation and processing of ore, disposal of overburden & tailings etc., are posing various complex situations for managing the ecology. Over the years the large scale mining operations in the forest areas, have caused substantial impact on the ecosystem like degradation of land, deforestation, displacement of wildlife, effect on aquatic eco-system etc.

The major adverse impacts due to pre mining and mining phases are loss of habitat, biodiversity, rare flora & fauna, other aquatic life, migration of wildlife and overall disruption of the ecology of the area. Major impacts of iron ore mining on ecology are as follows;

- Removal of vegetation (flora) from the area required for mining and other purposes, and thereby displacement of fauna.
- Pollution of water in the surrounding water bodies due to leaching from overburden dumps, seepage/overflow water from tailings pond and from the other activities. These affect the aquatic ecology of surrounding water bodies.
- Dust in the atmosphere, contributed by mining and associated activities, when deposits on the leaves of the plant in the surrounding area hampers the process of photosynthesis and retards their growth.
- Noise and vibrations due to blasting, movement of HEMM/vehicles and operation of fixed plants and machineries drive away the wild animals and birds from the nearby forests.
- Water scarcity caused due to the impacts of opencast mining on water regime affects the growth of vegetation and agricultural crops in and around the mines.
- Discharge of mine effluents to the nearby surface water bodies without proper treatment may affect vegetation in the surrounding area.

It is evident that mining and associated activities have considerable impacts on the ecology of the mining and surrounding areas. The ecological impacts are more severe in India as most of the iron ore mines are located in the dense forest areas and on hill tops. These impacts are evident in most of the iron mining zones in our country. By proper reclamation of mined out areas and rehabilitation of waste dumps through massive afforestation with local saplings, the ecological impacts can be minimised.

2.2 Scholarly work of different researchers

The following is a brief review of scholarly work of different researchers in the field of soil and water quality studies due to mining:

2.2.1 Soil Quality Monitoring In Mines Area

Ghosh (2004) was studied on the Effect of opencast mining on soil fertility. Ghosh carried out a no. of experiment on this so according to him in the process of opencast mining many changes occurs in the physical, chemical and biological properties of soil. The main problem in preserving mine soil is discussed. Every year large areas are continuously becoming unfertile in spite of efforts to grow vegetation on the degraded mined land one large opencast coal project of Eastern Coalfields Ltd. (ECL) is investigated in to assess the deterioration of soil properties due to stripping and stockpiling. Different age classes of mine soil dumps are identified for study. Mine soil characteristics of the dumps are compared with those of unmined soil and then analyzed critically to evaluate deterioration of soil properties with respect to time of stockpiling. The changes in soil quality were found to be drastic in the first year and continually deteriorating every year, and ultimately the soil became unfertile.

Mohapatra (2006) analyses soil around five opencast coal projects of lb river coalfield. Sampling of soil has been done from the vertical surface of the overburden at successive depths of 0-5 it, 5-10 ft. and at 10-15 ft. the different physical (soil texture, soil moisture, particle density, bulk density and porosity) and chemical (pH, organic carbon, nitrogen, phosphorus and potassium) parameters have been analyzed. The soil textures of the study area are found to be loamy sand to loam, loam to silty loam and clay loam to silty day loam in the depth of 0-5 ft., 5-10 ft. and at 10-15 ft., respectively. The organic carbon (1.367 at 0-51t, 0.9 al 5-10 ft. and 0.396 kg ha1 at 10-15 ft.), nitrogen (2.845 at 0-5ft, 1.059 at 5-lOft and 0.48 kg ha-1 at 10-15 fi) and phosphorus level (1.11 at 0-5f1, 0.115 at 5-10 f1 and 0.679 kg ha' at 10-15 f1) of the soil decreased with increasing depth of the soiI. However, the content of potassium (2.636 at 0-5ft, 4.374 at 5-lOft and 5.82 kg ha1 at 10-15 It) increased gradually from the surface to the greater depth. Analysis of variance is computed to infer the variation in the concentration of parameters in different opencast coal projects and in various depths of the study area.

Chaudhari (2006) carried out an integrative assessment of soil and water quality monitoring they study in seven coal mines are situated in Wardha River Valley. These mines are located at Wani (Dist. Yavatmal of Maharashtra). Out of these, 5 open cast coal mines are run by Western Coal Field Ltd. India. The present study has been undertaken to assess the impacts of mining

activities in the adjacent areas. They found concentration of fluoride in surface soils in Vallioor Union of Tirunelveli district of Tamilnadu causes a serious dental and skeletal fluorosis, if present in higher concentration exceeding 1.5 ppm in water and 1 ppm and 5 ppm in soil respectively. Fluoride in the surface soil was found in the range of 2.88. 9.82 ppm, which affects the growth of crops. In the present study, the fluoride concentration in water and soil ranged from 0.7.1.3 and 3.2.5.9 ppm respectively. Thus, the present investigation shows that the fluoride levels in the area studied are within the desirable limits.

The parameters studied in the surface water, dug well, bore well, etc. found within the desirable limits of IS: 10500. Only hardness exceeded the prescribed maximum limit by 3.3%. The water contamination is therefore still in non – hazardous range.

Verma (2008) carried out improper disposal of overburden (OB) and tailings causes' severe soil pollution. Therefore present study was carried out on overburden, their leaching levels and their effect on nearby water environment at Chiria mines of West Singhbhum district of Jharkhand, India. Studies revealed that the OB samples were neutral to marginally alkaline in nature (pH 7.2-7.6) with EC 0.07-0.09 ms/cm, Ca 0.75-1.30 mg/l, Mg 1.01-1.43 mg/l, Na 0.01-0.04 mg/l & K 0.08-0.12 mg/l. Low Cation Exchange Capacity & Nutrient content indicates poor productivity of overburden soil. OB showed higher concentration of Fe along with Mn, Pb and Zn as a typical characteristic of iron ore. OB was leached with acidic and distilled water and showed the presence of heavy metals at higher concentrations in acidic and low concentrations in distill water extract.

Cvetkovska (2009) did the rearch on soil protection activities and soil quality monitoring in south eastern Europe and they found that In the last decade soil and soil protection are becoming recognized as an important environmental topic. In in south eastern Europe wide diversity of soil types present in this area. The list of soil types could start from deep and fertile Chernosems of Vojvodina to the shallow Rendzinas and Rankers in the mountainous Bosnia, Gleysols of Croatia and to the salinized soils in Macedonia, to name just a few. Soils of the area are facing a number of possible threats which are are trans-boundary and so must also be the soil protection activities and actions. Completion of measures has not been recorded with none of the identified hotspots. With regard to economic activities contributing to soil contamination expressed in percentage,

the highest share belongs to mining with 43.75%, followed by metallurgy with 31.25%, organic chemical industry with 12.5% and refinery and leather manufacturing industry with 6.25%.

Romero (2011) did the research and found the hazard of the pollutants in the soils not only depends on their total concentration, but particularly on their availability. The mobility of the trace elements depends on their speciation, and it is also affected by several soil parameters. Mining activity is one of the most important anthropogenic causes of soil pollution. As a case study, this work is focused in the Riotinto mining area (Iberian Pyrite Belt, IPB, SW Spain). The IPB is one of the most important metallogenic provinces in the world and it has been exploited for thousands of years. The results showed that mining activity has caused high levels of As, Cu, Pb and Zn in several cultivated soils. Moreover, Cu, Pb and Zn showed a high bioavailability. This suggests that at least other studies are necessary to preserve health in the inhabitants of this area. The methodology carried out in this work allowed to select potentially polluted areas where agricultural activities are not recommended.

2.2.2 Water Quality Monitoring In Mines Area

Singh (1997) did a number of experiments on Environmental Impact Assessment of Mining Projects and concluded that the major impacts of mining are water pollution due to the erosion, oil and grease, contamination of water bodies due to the discharge of mine water effluents, leachates from wash-off dumps, solid waste disposal sites, toxic wastes, salinity from mine fires, acid mine drainage etc. He listed major mitigation methods as follows: Overburden run-off collection and treatment with subsequent sediment control, Oil and grease separators, Collection/storage of leachates, seepages, wash-offs with subsequent treatment, Proper sanitation and provision of the domestic and the sewage effluents treatment, Treatment of mine water discharges.

He suggested that there is an acute shortage of water supply in mining areas, augmentation of underground pumped out mine water for various supplies can be provided. This is a very economically cost-effective and provides savings towards water and energy conservation while giving the environmental and the social benefits.

Roy et al. (2003) after carrying out a number of experiments found out that mining affects huge area of the land and affect the quality of surface and underground water by adding contaminants and toxic compounds making it unsafe for drinking and industrial usage, disturbing the hydrology of the area. They discovered that the major sources of liquid effluents were: surface run-off, mine water pumped put during drainage operation, spent water from handling plants, dust extractors and dust suppression systems, effluents from preparation and beneficiation plants, and leaches/wash-off from waste/tailing dumps. Plant spillage, truck haulage, conveyor transfer points, and rail wagon loading areas, are common sources contributing fines top the surface run-offs. Abandoned mill tailings, coal refuse heaps, spoil heaps, and other waste dumps in mining area contain significant amounts of dissolved minerals, are chronic sources of stream pollution, apart from presenting eye-sore sights. Mining is also responsible for changing the hydrology of an area in many ways. Subsidence due to underground mining affects underground water, disruption of surface drainage patterns and resulting contribution to stream pollution. Sometimes it may change the river course and discharge, there by affecting the agriculture and flora and fauna of the area.

Lambert (2004) worked on the Long-term changes in quality of discharge water from abandoned underground coal mines and he observed that in several areas of Appalachian coal fields and in coal mining regions of the UK, mine water acidity and iron load are most severe in the first years after a discharge begins, but decreases steadily and substantially with the time. Their study was to document the extent of the water-quality changes in the Uniontown Syncline acid mine drainage discharges, and to investigate the geochemical and hydraulic factors responsible for changes. While in the operation, the advantage of these mines was the fact that water did not pool and hinder mining activities, but rather travelled down slope and out of the mine. The discharge from Uniontown Syncline Pittsburgh Coal seam flow in to two major streams, or their tributaries: the Youghiogheny River in the north part of the Syncline, and Redstone Creek in the south part. But the method followed for this study included: Sample collection from the 22 sites and field measurements of pH, temperature, dissolved oxygen, conductivity, ferrous iron and flow. Results were recorded and compared with results from Scarlift study. Thus Long-term changes in quality of abandoned underground coal mine discharges were studied. The study presented the clear evidence for natural improvement of the

quality of drainage for abandoned mine discharges. They suggested that the type and magnitude of the water-quality changes that occurred over time, mainly depends on degree of flooding within the mine voids contributing to discharges and the time elapsed since mine abandonment.

Heyden (2005) carried out a number of experiments and observed that the use of wetlands to treat mine effluent has grown in popularity over the past two decades, although the processes by which the natural systems function are often poorly understood. This field-scale investigation utilises daily data over a 9-month period in assessing the processes leading to the remediation of mine effluent within a natural wetland on the Zambian Copper belt. The study differentiates effluent remediation through dilution from pollutant retention. Decreased wetland outflow concentrations of SO4 and Na are due to dilution only, while Co (50%) and especially Cu (83%) are retained within the wetland. Retention was linked to adsorption onto new or primed surfaces during an initial period of effluent release into the system and to processes related to pH buffering to 7.5. The wetland's acid buffering capacity was largely the result of carbonate-rich groundwater discharge into the wetland. Although this buffering capacity likely shows little seasonal fluctuation (20–80 kmol/day), the impact of acidic effluent input on the wetland itself probably varies markedly between seasons, owing to the temporal and spatial characteristics of discharge from the catchments aquifers. Assessment of other natural wetlands in the region indicated that some (circa 15%) showed similar catchment size, hydrochemical and hydrogeological characteristics as those of the New Dam wetland, likely demonstrating a similar effluent remediation potential as that described here.

Roychoudhury (2006) comprehended and assessed the potential threat of metal pollution from dewatering of Grootvlei Gold Mine effluent into the Blesbokspruit, a Ramsar certified wetland site, the Witwatersrand rock of this area contains sulphide minerals, like pyrite pyrrhotite, arsenopyrite, chalcopyrite, galena cobaltite, gersdorffite, Fe, Ni, Pb, Cu, Co, As and U-bearing leachable oxides (Scott). Groundwater seeps through the mineral reef, therefore, has high Fe, SO4 and trace metal content. Effluent pumping subsequently resulted in disposal and dispersal of trace metals in the surface water system. Blesbokspruit stream recharges the local dolomite aquifer. The poor water quality therefore is likely to impact the freshwater resources in the area like Vaal River. The assessment was carried out by Surface water and sediment sampling,

determination of Water chemistry by pH, electrical conductivity (EC), dissolved O2 (DO), redox potential (Eh), temperature, ion Chromatograph (Dionex, DX500) and atomic absorption spectro-photometry test, which was followed by Leachate test using ICP-MS., CHN analyzer to determine the organic C in the sediment. They also assessed the Sediment quality by determining Enrichment factor (Ef), Geoaccumulation index (Igeo), Metal pollution index (MPI) and Sediment quality guideline index (SQG-I).

Kumar (2008) says the chemical characteristics of surface, groundwater and mine water of the upper catchment of the Damodar River basin were studied to evaluate the major ion chemistry, geochemical processes controlling water composition and suitability of water for domestic, industrial and irrigation uses. Water samples from ponds, lakes, rivers, reservoirs and groundwater were collected and analysed for pH, EC, TDS, F, Cl, HCO_3, SO_4, NO_3, Ca, Mg, Na and K. In general, Ca, Na, Mg, HCO_3 and Cl dominate, except in samples from mining areas which have higher concentration of SO_4. Water chemistry of the area reflects continental weathering, aided by mining and other anthropogenic impacts. Limiting groundwater use for domestic purposes are contents of TDS, F, Cl, SO_4, NO_3 and TH that exceed the desirable limits in water collected from mining and urban areas. The calculated values of SAR, RSC and %Na indicate well to permissible use of water for irrigation. High salinity, %Na, Mg-hazard and RSC values at some sites limit use for agricultural purposes.

CHAPTER: 3

EXPERIMENTAL PROCEDURE

CHAPTER: 3

EXPERIMENTAL PROCEDURE

3.1 SAMPLING

3.1.1 Soil Sampling

The method and procedure for obtaining soil samples vary according to the purpose of sampling. Analysis of soil samples may be needed for engineering and agricultural purposes. In this publication, soil sampling for agricultural purpose is described which is done for soil fertility evaluation and fertilizer recommendations for crops. The results of even very carefully conducted soil analysis are as good as the soil sample itself. Thus, the efficiency of soil testing service depends upon the care and skill with which soil samples are collected. Non-representative samples constitute the largest single source of error in a soil fertility programmed. It is to be noted that the most important phase of soil analysis is accomplished not in a laboratory but in the field where soils are sampled. Soils vary from place to place. In view of this, efforts should be made to take the samples in such a way that it is fully representative of the field. Only one to ten gram of soil is used for each chemical determination and represents as accurately as possible the entire surface 0-22 cm of soil, weighing about 2 million kg/ha.

Sampling tools and accessories

Depending upon the purpose and precision required, following tools may be needed for taking soil samples.

• Soil auger- it may be a tube auger, post hole or screw type auger or even a spade for taking samples.

• A clean bucket or a tray or a clean cloth for mixing the soil and sub sampling.

• Cloth bags of specific size.

• Copying pencil for markings and tags for tying cloth bags.

• Soil sample information sheet.

Sampling procedure

Prepare a map of the area to be covered in a survey showing different sampling unit boundaries. A plan of the number of samples and manner of composite sampling is entered on the map,

different fields being designated by letters A, B, C etc. Each area is traverse separately. A slice of the plough-layer is cut at intervals of 15 to 20 steps or according to the area to be covered. Generally 10 to 20 spots must be taken for one composite sample depending on the size of the field.

Scrap away surface liter; obtain a uniformly thick slice of soil from the surface to the plough depth from each place. A V-shaped cut is made with a spade to remove 1 to 2 cm slice of soil. The sample may be collected on the blade of the spade and put in a clean bucket.

In this way collect samples from all the spots marked for one sampling unit. In case of hard soil, samples are taken with the help of augur from the plough depth and collected in the bucket. Pour the soil from the bucket on a piece of clean paper or cloth and mix thoroughly. Spread the soil evenly and divide it into 4 quarters. Reject two opposite quarters and mix the rest of the soil again. Repeat the process till left with about half kg of the soil, collect it and put in a clean cloth bag. Each bag should be properly marked to identify the sample.

The bag used for sampling must always be clean and free from any contamination. If the same bag is to be used for second time, turn it inside out and remove the soil particles. Write the details of the sample in the information sheet. Put a copy of this information sheet in the bag. Tie the mouth of the bag carefully.

Precautions

• Do not sample unusual area like unevenly fertilized, marshy, old path, old channel, old bunds, area near the tree, and site of previous compost piles and other unrepresentative sites.

• For a soft and moist soil, the tube auger or spade is considered satisfactory. For harder soil, a screw auger may be more convenient.

• Where crops have been planted in rows, collect samples from the middle of the rows so as to avoid the area where fertilizer has been band placed.

• Avoid any type of contamination at all stages. Soil samples should never be kept in the store along with fertilizer materials and detergents. Contamination is likely when the soil samples are spread out to dry in the vicinity of stored fertilizers or on floor where fertilizers were stored previously.

• Before putting soil samples in bags, they should be examined for cleanliness as well as for strength.

• Information sheet should be clearly written with copying pencil.

The soil samples are collected from the Bolani Iron Ore Mines. The details of the sample collected are as presented in table 3.1.

Table 3.1: Soil Samples with their respective Locations and Identity

Sl. No.	location	Sample Id	Date of collection
1.	Bolani Iron Ore Mine D-area	S1	18-08-2012
2	Bolani Iron Ore Mine G-area	S2	18-08-2012
3	Bolani Iron Ore Mine F-area	S3	18-08-2012
4	Bolani Iron Ore Mine D-area(2)	S4	18-08-2012
5	Bolani Iron Ore Mine near water tank 1	S5	18-08-2012
6	Bolani Iron Ore Mine near water tank 2	S6	18-08-2012
7	Bolani Iron Ore Mine forest land of F-area	S7	13-04-2013

8	Bolani Iron Ore Mine from tailing pond discharge point	S8	13-04-2013

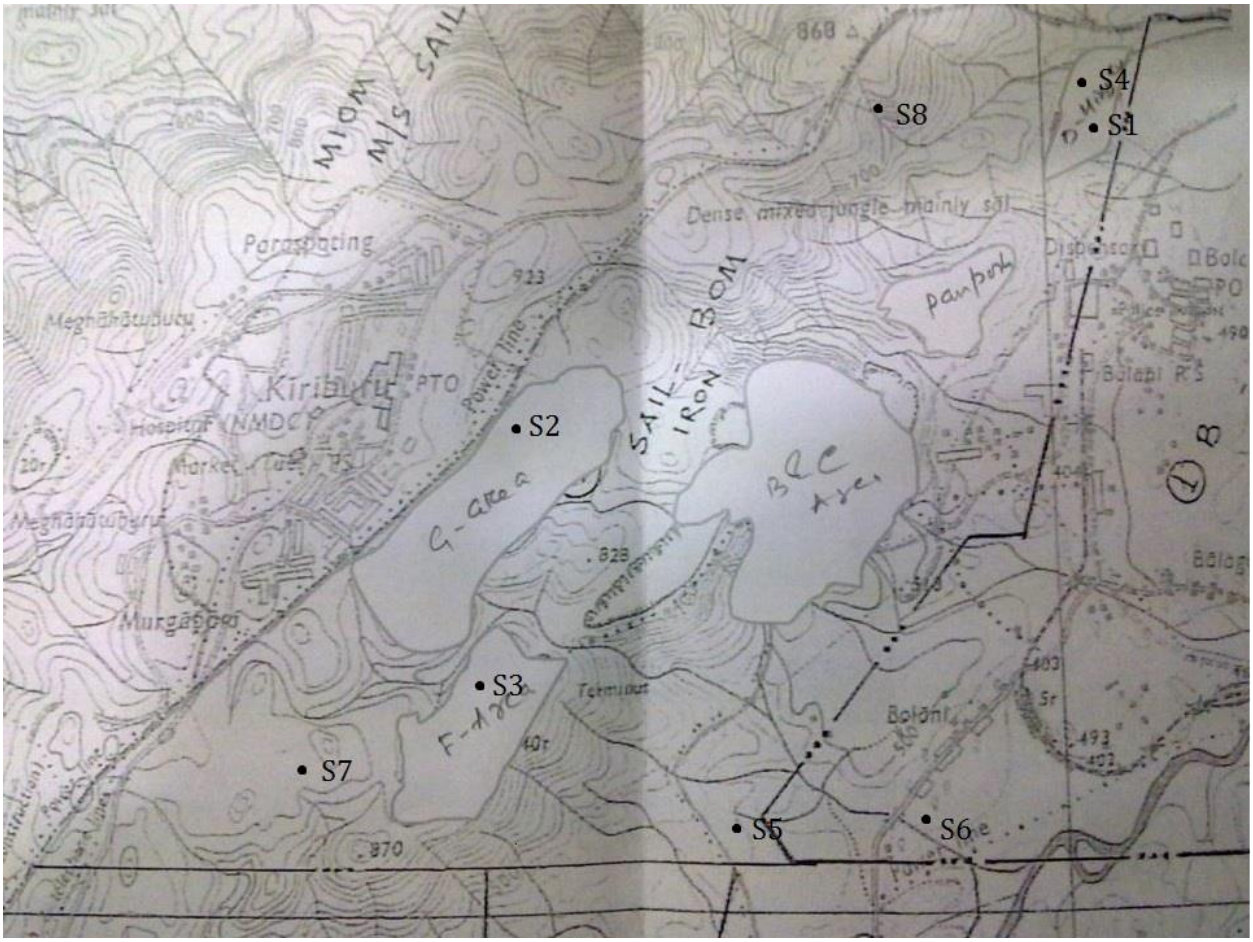

Figure 3.1: Sampling points of Bolani Iron Ore Mines

3.1.2 WATER SAMPLING

The objective of sampling is to collect representative sample. Representative sample means a sample in which relative proportions or concentration of all pertinent components will be the same as in the material being sampled. Moreover, the same sample will be handled in such a way that no significant changes in composition occur before the tests are made. The following points should be kept in mind while collecting water samples.

Sample Volume: The sample volume depends on the elements or substances required to be analyzed on their expected concentration in the sample. For trace metal analysis sample volume of about 100 ml is sufficient in most cases. For the analysis of organic parameters 1 L samples are commonly used.

Number of Samples: The number of samples required largely depends on the problem at hand. To get an average concentration several samples are collected as per a general calculation of the necessary number of samples.

Storage and Conservation: To prevent any kind addition of contaminants, loss of determinants by sorption or other means, and any other unintended changes that effect the concentrations of determinants of interest proper preservation must be carried out. For this purpose, long-term storage with negligible composition change must be preferred.

Contamination: There are always chances of contamination of samples during the sampling process, either from external sources or from contaminated sampling or storage equipment. Polyethylene or Teflon bottles must be used for inorganic analysis, and glass or quartz bottles in organic trace analysis.

SAMPLE COLLECTION PROCEDURE

The procedure of collection of samples is as follows:

- It is ensured that all sampling equipment is clean and quality-assured before use. Use sample containers that are clean and free of contaminants.
- Sample containers were filled without pre-rinsing with sample; pre-rinsing results in loss of any pre-added preservative.
- Special precautions are necessary for samples containing trace metals.
- Since many constituents may be present at low concentrations, they may be totally or partially lost or easily contaminated when proper sampling and preservation procedures are not followed.

The followings were recorded during sample collection

- o General information
- o Sample identification number
- o Location

o Sample collector

o Date and hour

o Sample type (Grab or composite)

Grab sampling is followed during the sampling. Grab samples are collected at a specific spot at a site over a short period of time (typically seconds or minutes). Thus, they represent a "snapshot" in both space and time of the sampling area. Discrete grab samples are taken at a selected location, depth, and time.

Grab samples sampling is followed as it is known that the composition of the water source near mines changes frequently depending upon weather and also waste discharge interval.

When a source is known to vary with time, grab samples collected at suitable intervals and analyzed separately can document the extent, frequency, and duration of these variations. The sampling is done by manual method. All the samples are collected from B.S.L. mines. The details of the sample collected are as presented in table 3.2.

Table 3.2: Water Samples with their respective Locations and Identity

Sl. No.	**Location**	**Sample Id**	**Date of Collection**
1	Gurupahar abandoned lime stone mine	W1	21-01-2013
2	Gurupahar working limestone mine	W2	21-01-2013
3	Patpahar abandoned dolomite mine	W3	21-01-2013

4	Patpahar working dolomite mine	W4	21-01-2013

Figure 3.2: Water sampling points

3.2 EXPERIMENTAL METHODOLOGY

3.2.1 Soil Quality Assessment

For monitoring of the top soil in the opencast mine first we follow all the above procedure for the collection of the sample and preparation of the sample. When all the samples are ready for the testing then we go for the tests. Soil quality test is done by orlab soil testing kit. We will see here for the following parameters:

- Soil pH
- Soil Organic Carbon
- Soil Nitrate-Nitrogen
- Soil Ammonical Nitrogen
- Calcium
- Magnesium
- Potassium
- Sulphur

Figure 3.3 Orlab soil monitoring kit

So these are the parameters for which we will do the tests. All of these tests may be run on fresh soil samples. However, the accuracy of the tests depends on getting a representative subsample, often using a very small scoop, to run each test. If the soil you have sampled is dry and crumbly, or dry and can be crushed to a fine dust, you may proceed without further processing. If the soil is moist, but still crumbly, you may also proceed, but use care to get an accurate and representative subsample in each scoop. If the soil is dry and cloddy, or very wet, you may need to do the following steps. First, air dry the sample until completely dry. Then crush the sample, using either a hammer on a hard surface, mortar and pestle, or other method. Finally, sieve the

sample through a coarse screen, so that you have a representative, but finely ground sample to work with.

3.2.1.1 pH

pH is a measure of acidity or basicity. Soils can have a pH from 3.5 to 11.0, but plants grow well in the range of 5.0 to 8.5. In soils with a low pH (acidic), some nutrients can reach toxic levels and the activity of soil microbes is greatly reduced. Soils with a high pH (alkaline) generally have a lower micro-nutrient availability and some levels may be deficient.

Estimation of Soil pH

1. Take 5 grams of soil with the help of 5 gm spatula in to Plastic conical flask with cap.
2. Add a pinch of activated carbon with the help of plastic red spoon to it.
3. Add 10 ml of deionized water with the help of 10 ml measuring cylinder.
4. Replace the cap and mix the contents for 5 minutes.
5. Filter the suspension ¡n to a 10 ml test tube with the help of a plastic funnel and filter paper.

6 Collect 2 ml of filtrate into 10 ml test tube.

7. Add 3 to 4 drops of pH Reagent and shake thoroughly.
8. Compare the color of the suspension with pH color chart and note down the soil pH.

The ratings of soil pH are as under

Table 3.3 pH ratings

Soil pH	Ratings
9	Harmful to all crops
8-9	Harmful to most of the crops

6-8	Good for all crops
6-5	Harmful to most of the crops
<5	Harmful to all crops

3.2.1.2 Organic Carbon

Organic carbon place a major in deciding biological activity as well as fertility of the soil. Organic carbon content of soil in India is relatively lower and manure support becomes mandatory. Soil organic carbon content up to 1.5% or 2.0% increase soil porosity that supposed to growth of the soil microorganism.

Estimation of Soil Organic Carbon

1. Take 1gm of soil with the help of 1 gm. spatula into plastic conical flask with cap.
2. Add 10 ml of Organic carbon Reagent A with the help of 10 ml measuring cylinder to it.
3. Add 10 ml of Organic carbon Reagent B with the help of 10 ml measuring cylinder to it.
4. Replace the cap arid mix gently for 2 min and allow it to stand for 10 to 15 minutes.
5. Filter through a given plastic funnel and filter paper. (Note: If soil contains more clay particle which can be seen by sticky nature of soil and the dull color of filtrate then again filter the solution with the help of given syringe filter)
6. Compare the color of clean filtrate with the given color chart.
7. The organic carbon content of your soil is the assigned value of most matching color on the standard chart.

Table 3.4 Ratings of Soil on the basis of Organic Carbon

Organic Carbon	Rating
<0.5%	Low
0.5%-1.0%	Medium
>1.0%	High

3.2.1.3 Nitrate Nitrogen (NO_3-N)

More than 90% of soil Nitrogen exists in complex combination in the organic matter (humus) fraction. It becomes available to crops after breakdown to simple forms followed by mineralization. This type of transformation is mostly biological in nature. Therefore methods involving in determination of mineral form Nitrogen i.e. NH4-N and N03-N.

Estimation of Soil Nitrate Nitrogen (N03-N)

1. Take 1 gm. of soil with the help of 1 gm. spatula into plastic conical flask with cap.
2. Add a pinch of Nitrate Reagent powder with the help of plastic red spoon to the same sample flask.
3. Using 10 ml graduated cylinder measure 10 ml of deionized water and transfer it to the sample flask.
4. Repeat steps 1-3 for each soil sample undergoing extraction.
5. Cap and shake each flask vigorously for 2 minutes.
6. Using a plastic funnel and filter paper, filter the content of the flask into 10 ml test tube.
7. Add the content of Nitrate A tablet to sample test tube.
8. Add the content of Nitrate B tablet to sample test tube.
9. Replace the rubber cork and shake the test tube vigorously, until the tablets dissolved completely for 2 minutes.
10. After shaking, wait for 6 minutes reaction period complete.
11. Place the test tube on Nitrate-Nitrogen (N03-N) color chart and compare with the chart.

12. Record the Nitrate-Nitrogen in Kg/hec.

Note: Soil extract quantity & time factor is very important color matching must be done immediately after 8 minutes from the time of mixing. Delay in time will lead to wrong result.

3.2.1.4 Ammonical Nitrogen (NH_4-N):

Nessler's reagent, which is an alkaline solution of Mercury (II) Iodide in Potassium Iodide, is used for the determination of Ammonium In this method, Nessler's reagent is added to a solution of ammonium salt when a reaction occurs between the liberated ammonia and the reagent. The orange brown product formed as to be compared with color chart and Ammonium Nitrogen (NH4-N) is determined.

Estimation of Soil Ammonical Nitrogen (NH_4-N)

1. Take 1 gm. of soil with the help of 1 gm. spatula into plastic conical flask with cap.
2. Using 25 ml graduated cylinder measure 15 ml of Nitrogen Ammonia extractant and transfers it to the same sample flask.
3. Repeat steps 1-2 for each soil sample undergoing extraction.
4. Cap and shake each flask vigorously for 2 minutes.
5. Using a plastic funnel and filter paper, filter the content of the flask into 10 ml test tube.
6. Add 4 drops of Ammonia Reagent I and replace the rubber cork and shake the test tube gently.
7. Open the rubber cork and add 4 drops of Ammonia Reagent 2. Replace the rubber cork and shake the test tube vigorously for one minute.
8. Place the test tube on Ammonical-Nitrogen color chart and compare with the chart and express the result as NH4-N Kg/hec.

3.2.1.5 Calcium

Soil biological life is the key to profitable plant nutrition and that biological life has a definite need for the element calcium. The beneficial biology of the soil complex are aerobic by nature and respond very favorably to the porosity of the soil complex which is provided by the

flocculation of the exchange complex by the calcium cation. Also, soil biology feeds very heavily on available calcium in soil to supply the needs of their bodily functions.

Preparing the solution for estimation of calcium and magnesium

1) Take 2 gm. of Soil with the help of 2 gm. spatula into plastic conical flask with cap.

2) Add a pinch of activated carbon with the help of plastic red spoon to it.

3) Using 25 ml graduated cylinder measure 20 ml of Mehlich extractant and transfer to the same sample flask.

4) Repeat steps 1-2 for each soil sample undergoing extraction.

Note: To prevent confusion when working with several samples label each sample flask with soil number.

5) Using a plastic funnel and filter paper, filter the content of the bottle into another flask.

6) Use the filtered extract for Calcium and Magnesium analysis.

Estimation of Calcium + Magnesium

1. Using the 3 ml dropper take 1 ml of the filtered sample extract ¡n to 125 ml conical flask.

2. Add 25 ml deionized water to the same conical flask.

3. Add 23 drops of Ca+Mg Buffer to the same conical flask.

4. Open the EBT indicator tablet and add the conical flask.

5. Swirl to mix. The color will change to wine red if Ca + Mg ¡s present.

6. Add EDTA Standard solution drop wise while swirling to mix after each drop. Continue adding and counting the drops until the color changes to blue.

7. The Ca + Mg meq/100g is equal to the number of drops of EDTA standard solution used in step (6) X 5 factor.

Ca + Mg meq/100g = No. of drops X 5

Estimation of Calcium

1. Using the 3 ml dropper take I ml of the filtered sample extract in to 125 ml conical flask.

2. Add 25 ml deionized water to the same conical flask

3. Add 12 drops of Calcium Buffer to the same conical flask.

4. Add one plastic red spoon of Calcium indicator powder to the same conical flask.

5. Swirl to mix. The color will change to pink if Calcium is present.

6. Add EDTA standard solution drop wise while swirling to mix after each drop.

Continue adding and counting the drops until the color changes to purple.

The Calcium in meq/100g is equal to the total number of drops of EDTA standard solution used in step (6) X 5.

Calcium meq/100g = No. of drops X 5

3.2.1.6 Magnesium

Magnesium is a component of several primary and secondary minerals in the soil, which are essentially insoluble, for agricultural considerations. These materials are the original sources of the soluble or available forms of Mg. Magnesium is also present in relatively soluble forms, and is found in ionic form (Mg^{++}) adhered to the soil colloidal complex. The ionic form is considered to be available to crops.

Estimation of Magnesium

Magnesium in meq/100g = Ca + Mg meq/100g —Ca meq/100g.

3.2.1.7 Available Potassium

Potassium (K) is an essential nutrient for plant growth. Because large amounts are absorbed from the root zone in the production of most agronomic crops, it is classified as a macronutrient. Minnesota soils can supply some K for crop production, but when the supply from the soil is not adequate, K must be supplied in a fertilizer program. This publication provides information important to the basic understanding of K nutrition of plants, its reaction in soils, its function in plants, and its role in efficient crop production.

Preparation of sample for Available Potassium as K_20

1. Take 2 gm. of Soil with the help of 2 gm. spatula into plastic conical flask with cap.

2. Using 25 ml graduated cylinder measure 20 ml of Potassium extractant and transfer to the same sample flask.

3. Repeat steps 1-2 for each soil sample undergoing extraction.

Note: To prevent confusion when working with several samples, label each sample flask with soil number.

4. Using a plastic funnel and filter paper, filter the content of the bottle into another flask.

5. Use the filtered extract for Potassium analysis.

Sample analysis procedure

1. Using the 3 ml dropper take 3 ml of the filtered sample extract in to 25 ml graduated Measuring cylinder.

2. Make up to 21 ml mark with deionized water.

3. Add 3 ml of Potassium Reagent I and firmly close the cylinder with finger and invert to mix.

4 Add 10 drops of Potassium Reagent 2 and invert to mix.

5. Add 2 plastic red spoons of Potassium Reagent 3 and firmly close the cylinder with finger and shake vigorously for I min.

6. Allow the solution to stand for 5 min but no longer than 10 min. A white turbidity will develop.

7. While looking straight down into the cylinder slowly insert the Potassium dip stick vertically into the solution until the black dot is no longer visible from above the cylinder.

8. Hold the dip stick in that position and see the scale on the dip stick. Look across the surface of the sample to the scale on the dip stick.

9. Record the number in mm on the dip stick scale where the surface of the sample meets the dip stick scale.

10. Repeat steps 7-9 two more times recording the value each time. Take the average of the 3 readings.

11. Refer to the Potassium conversion table mention below to determine the level of Potassium in soil.

12. When analysis is complete rinse the lab ware with deionized water.

Table 3.5 Potassium conversion

Dip stick reading in mm	Potassium as K in Kg/hec.	Potassium as K_2O in Kg/hec.	Result
>85	<125	<150	Low
85-60	125-250	150-300	Medium
55-20	>250	>300	High

3.2.1.8 Available Sulphur

Sulphur (S) is an essential plant nutrient required by all crops for optimum production. Plants take up and use S in the sulphate (SO4-S) form, which like nitrate (NO3-N), is very mobile in the soil and is prone to leaching in wet soil conditions, particularly in sandy soils. Sulphur deficiencies are becoming increasingly common in Alberta. Deficiencies can be easily corrected with fertilizers containing sulphate (S04). Generally, S is the third most limiting soil nutrient in cereal, oilseed and forage crop production in Alberta. It is third only to nitrogen (N) and phosphorus (P) in fertilizer use in Alberta.

Sample analysis procedure

1. Take 5 ml filtered sample into 10 ml test tube.
2. Cut one Sulphur Reagent powder pouch with the help of scissor and transfer the powder into test tube.
3. Replace the rubber cork and shake vigorously 2 minutes.
4. Allow the solution to stand for 5 minutes; a white turbidity develops if Sulphur is present.
5. Compare with soil sulphur chart and record the available Sulphur value as
S04-S in ppm.
6. To convert Sulphur as S04-S from ppm to Kg/hec multiply with 2.24.

3.2.2 WATER QUALITY ASSESSMENT

Water quality is physical, chemical and biological characteristics of water. In present work, these characteristics are determined following the guidelines prescribed by the Bureau of Indian Standards and Central pollution control board (CPCB).

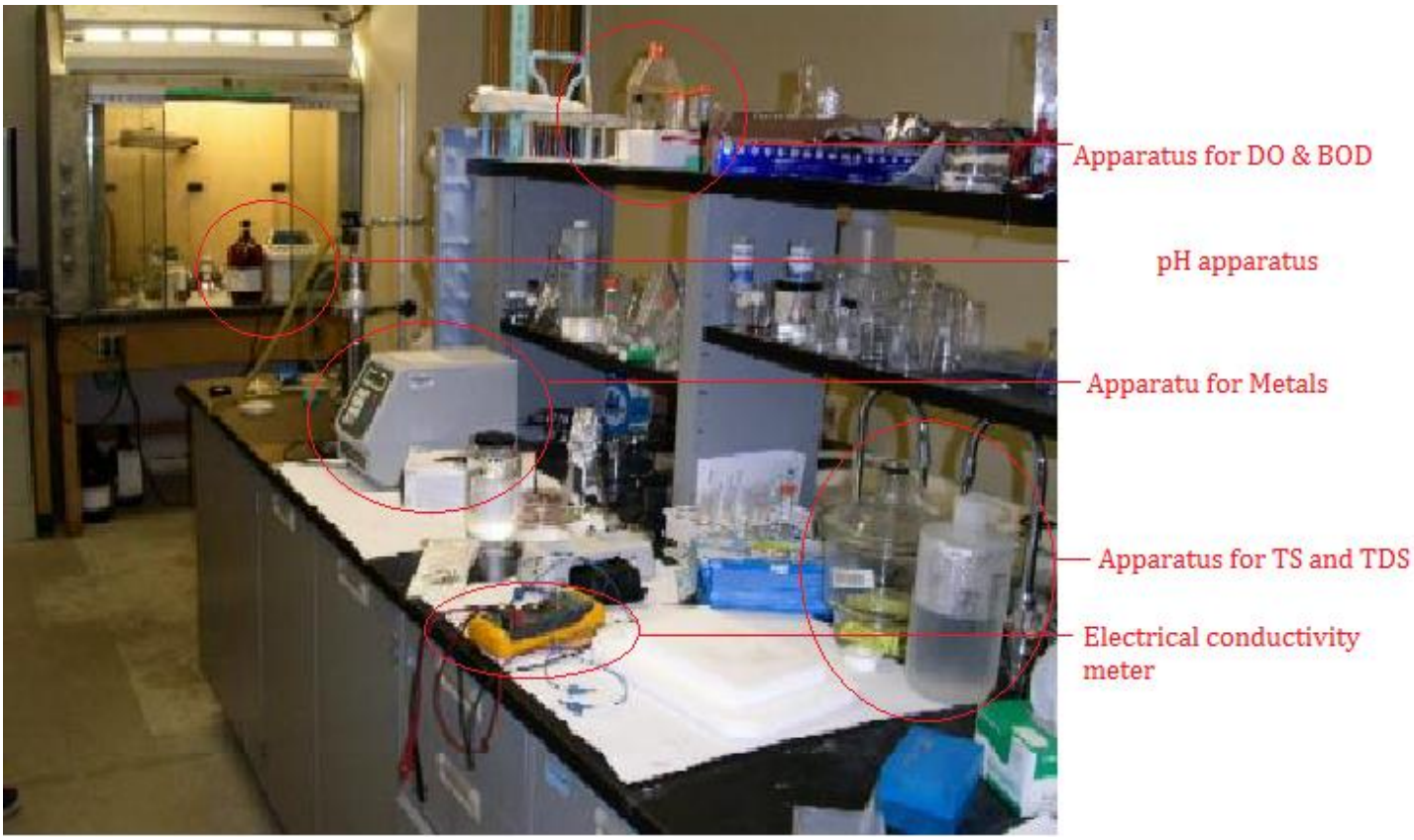

Figure 3.4 Water quality monitoring instruments

3.2.2.1 pH

The pH is determined by measurement of the electromotive force (EMF) of a cell comprising of an indicator immersed in test solution and a reference electrode (usually a calomel electrode). Contact is achieved by means of the liquid junction, which forms a part of the reference electrode. The EMF of that cell is measured with pH meter.

Since the pH is defined operationally on a potentiometric scale, this measuring instrument is also calibrated potentiometrically with an indicating electrode and a reference electrode using standard buffers having assigned pH value so that

Procedure:

1. Eectrodes are removed from storage solutions and rinse with distilled water.

2. Electrodes are dried by gently blotting with the soft tissue paper, and are standardized using a buffer solution within 2 pH units of sample pH.

3. Electrodes are removed from the buffer, and rinsed thoroughly with distilled water; then it dried.

4. Same standardization is followed with pH 10 buffer.

5. For samples analysis, equilibrium is established between electrodes and sample by stirring sample to ensure homogeneity and the measure pH.

3.2.2.2 Electrical Conductivity

This method used to measure conductance generated by various ions in the solution. Rough estimation of dissolved ionic contents of water sample can be made by multiplying specific conductance (in mS/cm) by an empirical factor which might vary from 0.55 to 0.90 depending on the soluble components of water and on the temperature of measurement.

Procedure: Conductivity can be measured as per the instruction manual supplied with the instrument and the results may be expressed as mS/m or mS/cm. The temperature at which measurement is made is noted down.

3.2.2.3 Total Solids

The term ‘solid’ refers to the matter either filterable or non-filterable that remains as residue upon evaporation and subsequent drying at a defined temperature. Water with high dissolved solids results in unfavorable physiological reaction in the consumer. It is also unsuitable for many industrial applications. High suspended solids in waters may be aesthetically unsatisfactory. Analysis of total solids is important to decide upon the various unit operations and processes in physical and biological wastewater treatment.

Procedure

1. The known volume of well-mixed sample is taken in a tarred dish ignited to constant weight (W1)

2. The sample is evaporated to dryness at 103-105°C for 24hrs.

3. Then it is cooled in desiccators, weighed and the reading is recorded. (W2)

4. The concentration is calculated in percent by weight.

Calculation

The total solids is expressed as:

Total solids, mg/L = (W2 - W1) x 1000 / mL of sample

3.2.2.4 Total dissolved solids

It is the filterable residue is the material that passes through a standard glass filter disk and remains after evaporation and drying at 180°C.

Procedure

1. The well-mixed sample is filtered under vacuum through membrane filter or Gooch Crucible.

2. 100mL or more filtrate is taken in a weighed evaporating dish.

3. Then it is evaporated to dryness on steam bath for at least 1 hour in an oven at 180±2°C and is cooled in a desiccator and weighed.

Calculation

Total filterable residue at 180°C = (A –B) x 1000 / C

Where:

A = weight of dried residue + dish

B = weight of dish

C = mL of filtrate used

3.2.2.5 Total suspended solids

It is found out by subtracting the total dissolved solids from the total solids.

3.2.2.6 Dissolved Oxygen

Dissolved Oxygen is the oxygen content of any water body. All aquatic organisms depend on this to sustain. So DO level helps to assess quality of raw water to keep check on pollution.

Procedure

1. Sample is collected in a BOD bottle.
2. 1mL $MnSO_4$ is added followed by 1mL of alkali-iodide-azide reagent to a sample collected in 250 to 300mL bottle up to the brim and then is repeatedly inverted to mix well.
3. The precipitate is allowed to settle. (It is white if the sample is devoid of oxygen, and becomes increasingly brown with rising oxygen content.)
4. 1mL conc. H_2SO_4 is added and the stopper is replaced and mixed well till precipitate goes into solution.
5. 201mL of this solution is taken in a conical flask and is titrated against standard $Na_2S_2O_3$ solution using starch (2mL) as an indicator. When 1mL $MnSO_4$ followed by 1mL alkali iodide-azide reagent is added to the samples as in (2) above, 2mL of original sample is lost. Therefore 201mL is taken for titration which will correspond to 200mL of original sample. 200 x 300/ (300-1) = 201mL

Calculation

1mL of 0.025N $Na_2S_2O_3$ = 0.2mg of O_2

DO in mg/L = (0.2 x 1000) x (0.025N) ml of thiosulphate / 200

3.2.2.7 Chemical Oxygen Demand

Chemical Oxygen Demand (COD) test determines the oxygen requirement equivalent of organic matter that is susceptible to oxidation with the help of a strong chemical oxidant. It is an important, rapidly measured parameter which provides the means of measuring organic strength for streams and polluted water bodies. The test can be related empirically to BOD, organic carbon or organic matter in samples from a specific source taking into account its limitations. This test is relatively easy, precise, and fast.

Procedure

Sample Preparation:

1. All samples high in solids are blended for 2 minutes at high speed and stirred when an aliquot is taken for analysis.

2. Proper volume of sample is selected based on expected COD range. (e.g. for COD range of 50-500 mg/L take 25-50mL of sample)

Calculations:

COD as mg/L = (a –b) x N x 8000 / mL sample

Where, a = mL FAS used for blank

b = mL FAS used for sample

N = normality of FAS

8000 = Mili eq. wt. of O2 x 1000

3.2.2.8 Hardness

Water hardness is a traditional measure of the capacity of water to precipitate soap. It is caused by dissolved polyvalent metallic ions. In fresh water, the principal hardness causing ions are calcium and magnesium which precipitate soap.

Total hardness is defined as the sum of the calcium and magnesium concentration, both expressed as CaCO3, in mg/L.

Procedure

1. 25 or 50mL well mixed sample is taken in porcelain dish or conical flask.

2. 1-2mL buffer solution is added followed by 1mL inhibitor.

3. A pinch of Eriochrome black T is added and then titrated with standard EDTA (0.01M) till wine red color changes to blue, the volume of EDTA required (A) is noted.

4. A reagent blank is run and the volume of EDTA (B) was found.

5. Volume of EDTA required by sample, C = (A-B) is calculated.

Calculation

Total hardness as $CaCO_3$ mg/L = C x D x 1000 / mL sample.

Where, C = volume of EDTA required by sample

D = mg $CaCO_3$ equivalent to 1mL EDTA titrant

3.2.2.9 Nitrate content

Nitrate is the highest oxidized form of nitrogen compounds that are present in natural waters. Chemical fertilizers, decayed vegetable and animal matter, domestic effluents, sewage sludge disposal to land, industrial discharge, leachates from refuse dumps and atmospheric washout are the significant sources of nitrate.

Though it can occur in all kinds of water bodies but it concentration may go higher in areas near coal mines due to their organic origin

Principle

Nitrate reacts with Phenol disulphonic acid and produces a nitro-derivative which in alkaline solution develops yellow color due to rearrangement of its structure. The colour produced follows Beer's law and is intensity proportional to the concentration of NO_3 present in the sample.

Procedure

1. Calibration: the colorimeter is calibrated using standard nitrate solution and calibration curve (absorbance Vs. Concentration) is plotted.

2. Color development:

a. The clarified sample is neutralized to pH 7.0.

b. Suitable aliquot of the sample is taken in a beaker and evaporated to dryness on water bath.

c. The residue is dissolved using glass rod with 2mL phenol disulphonic acid reagent. Then is diluted and transferred to Nessler's tubes.

D.8-10mL 12N KOH is added. If turbidity develops the EDTA reagent is added drop-wise till it dissolves.

e. The solution is filtered and made up to 100mL. To avoid turbidity 10mL conc. NH4OH is added instead of KOH.

f. Blank is prepared in the same way using distilled water in place of sample.

g. Then the sample is subjected to colorimetry and the intensity of colour developed at 410nm with a light path of 1cm is read.

Calculation

The concentration of Nitrate is calculated from the standard calibration curve and the values are reported in mg/L.

3.2.2.10 Sulphate

Sulphate occurs in natural waters in soluble form. They originate from oxidation of sulphate ore, presence of shale, from organic compounds. Sulphur-bearing mineral are common in most sedimentary rocks. In humid region, sulphate is readily leached from the zone of weathering by infiltrating waters and surface run off. Sulphate concentration is expected to be higher in areas near coal mines as minerals containing sulphur occur in coal deposits.

Ingestion of water containing high concentration of sulphate can have a laxative effect, which is enhanced when sulphate is consumed in combination with magnesium. Water containing magnesium sulphate at levels about 1000 mg/L acts as a purgative in human adults. Taste threshold concentrations for the most prevalent sulphate salts are 200-500mg/L for sodium sulphate, 250- 900mg/L for calcium sulphate, and 400-600mg/L for magnesium sulphate.

Procedure

1. Ba (+II) is added in excess under acidic conditions, BaSO4 is precipitated quantitatively. The reaction is allowed to continue for 2 hours or more at 80-90˚C. This is to encourage the formation of BaSO4 crystals (non-filterable) from the initially formed colloidal precipitate (partially filterable).

2. The precipitate is washed, and then dried at 800˚C for 1 hour. Low pH is needed to avoid the precipitation of BaCO3 and Ba3 (PO4)2. Positive bias may result from acid-resistant insoluble matter such as silica, Sulphites which may oxidize to Sulphate, and nitrate and chloride which

will associate with barium and co-precipitate to a small extent with the barium Sulphate. Negative bias may result from the presence of certain heavy metals (e.g., Cr, Fe) which can form soluble complexes with Sulphate.

Calculation

Mg SO42- /L = mg BaSO4 x 411.6/mL sample

3.2.2.11 Determination of Metals

Metal content of water can be determined through various ways, such as Atomic Absorption Spectrometric Method, Phenanthroline Method, and Titration Method. Out of which the Atomic Absorption Spectrophotometry (AAS) is the most sensitive, rapid and modern method. The accuracy of this method is very high. So in this work for determination of metals AAS is used.

Procedure

1. Sample is digested for the use during estimation.
2. Appropriate hollow cathode lamp is installed as per the metal whose content is desired to be found and proper wave length is selected for the different metals. The table of wavelength as per metal and sensitivity is given below.
3. Slit width is set according to manufacturer-suggested setting for the element being measured and then current is turned on and adjusted as suggested by the manufacturer, and then the instrument is left to warm-up until energy source stabilizes for about 10 to 20 min.
4. Wavelength is optimized by adjusting wavelength dial until optimum energy gain is obtained.
5. After installing suitable burner head, and allowing air flow as per maximum sensitivity acetylene is allowed and flame is ignited.
6. Calibration is performed by aspirating blank samples and standard samples and recording the absorbance of the respective ones.
7. After getting the calibration plot between concentration and absorbance, sample is analyzed for the particular metal.
8. The concentration of the metal is directly recorded from the digital display or read out.

CHAPTER: 4

Result and Discussion

CHAPTER: 4

Result and Discussion

4.1 RESULTS

4.1.1 Soil Quality Monitoring Results at Bolani

The values of pH, Organic Carbon, Nitrate and Ammonical Nitrogen, Calcium, Magnesium, Potassium and Sulphur obtained are tabulated below:

Table 4.1 Soil Quality Monitoring Results of Sample S1, S2, S3 & S4

PARAMETRERS	S1	S2	S 3	S 4	Limits
pH	5	5.5	5.5	6	**6-8**
Organic Carbon	<0.5%	<0.5%	<0.5%	<0.5%	**0.5-1%**
Nitrate Nitrogen (Kg/Hec.)	0	0	0 - 280	0 - 280	**280**
Ammonium Nitrogen (Kg/Hec.)	17	17	15	13	**-**
Calcium (meq/100gm)	15	20	15	15	**-**
Magnesium (meq/100gm)	0	5	5	10	**-**
Available Potassium (Kg/Hec.)	<150	<150	<150	<150	**150-300**
Available Sulphur (Kg/Hec.)	22.4	22.4	33.6	22.4	**40**

Table 4.2 Soil Quality Monitoring Results of S5, S6, S7 & S8

PARAMETRERS	S5	S6	S7	S8	Limits
pH	5	5.5	6.5	6	**6-8**
Organic Carbon	<0.5%	<0.5%	0.5-1%	<0.5%	**0.5-1%**
Nitrate Nitrogen (Kg/Hec.)	0	0	>280	0	**280**
Ammonium Nitrogen (Kg/Hec.)	17.	17	17	23	**-**
Calcium (meq/100gm)	10	15	10	5	**-**
Magnesium (meq/100gm)	0	5	10	0	**-**
Available Potassium (Kg/Hec.)	<150	<150	<150	<150	**150-300**
Available Sulphur (Kg/Hec.)	22.4	33.6	44.8	33.6	**40**

4.1.2 Water Quality Monitoring Results

The results of the water quality monitoring is tabulated below

Table 4.3 Water Quality Monitoring Results

PARAMETERS	W1	W2	W3	W 4	STANDARD (1S:10500) 1991	Max value effluent (IS:1069) 1993
pH	7.17	7.43	7.68	8.17	**6.5-8.5**	**5.5-9**
E.C. (Ms/Cm)	136	192	199	200	**300**	**-**
DO (Mg/L)	6.64	6.47	6.72	7.1	**5**	**5**
COD(Mg/L)	115.2	114.04	114.44	113.86	**250**	**250**
TDS(Mg/L)	433	471	422	384	**2000**	**2100**
Total Suspended Solids	76	72	74	69	**100**	**100**
Hardness (Mg/L)	158	157	159	154	**300**	**600**
Tubidity (Ntu)	26	23	32	27	**10**	**10**
Alkalinity (Mg/L)	138	136	142	131	**200**	**500**
Chloride (Mg/L)	94.4	92.38	56	50.4	**250**	**1000**
Nitrate (Mg/L)	5	4.65	3.39	3.25	**10**	**10**
Sulphate (Mg/L)	74.2	72.87	67.26	62.25	**150**	**400**

Calcium (Mg/L)	102	101	98	100	**75**	**-**
Magnesium (Mg/L)	56	56	61	54	**30**	**-**
Sodium (Mg/L)	15.35	17.25	12.64	17.21	**-**	**-**
Potasium (Mg/L)	1.42	1.32	1.01	1.64	**-**	**-**
Iron (Mg/L)	0.27	0.23	0.37	0.16	**1**	**3**
Copper (Mg/L)	NIL	NIL	NIL	NIL	**0.05**	**1.5**
Manganese (Mg/L)	NIL	NIL	NIL	NIL	**0.1**	**0.3**
Lead (Mg/L)	NIL	NIL	NIL	NIL	**0.5**	**0.1**
Zinc (Mg/L)	NIL	NIL	NIL	NIL	**5**	**15**

4.2 DISCUSSION

4.2.1 Soil Quality

The 8 samples from different points of Bolani Iron Ore mines was analyzed.

pH

The value range of pH of Bolani iron ore mines samples is 5 to 6.5.

Organic Carbon

Most of the soil samples have the organic carbon content <0.5%. Organic Carbon improves the physical properties of soil. It increases the cation-exchange capacity (CEC) and water-holding capacity of sandy soil, and it contributes to the structural stability of clay soils by helping to bind

particles into aggregates. Sample S7 has organic carbon 0.5% -1% so it is in the medium range so this area soil is better from all other in respect to organic carbon percentage.

Soil Nitrogen

Soil Nitrogen in the soil is the most important element for plant development. It is required in large amounts and must be added to the soil to avoid a deficiency. Nitrogen is a major part of chlorophyll and the green color of plants. Soil samples S1, S2, S5, S7 and S8 have a very low quantity of nitrogen which is not good for the soil.

Calcium and Magnesium

Ideal soil should have following saturations of exchangeable cations 65% Ca, 10% Mg, 5% K, and 20% H. The cation ratios concentrations are a Ca: Mg of 6.5:1. The Ca: Mg ratio of soil samples varies from 1:1 to 4:1. The soil samples S2, S3 and S6 have satisfactory Ca: Mg ratio.

Sulphur

Sulfur comes naturally from regional rocks and acid rain. Most sulfur is found in organic matter and must be converted to sulphate for the crop to use it. The desirable limit of sulphur in the soil should be over 40 kg/ha in soil is considered good. So it found that the sulphur range in S1 to S8 is varies from 22.4 kg/ha to 44.8 kg/ha. The sample which are considered as good is S7, it has the sulphur value 44.8 kg/ha.

4.2.2 Water Quality

All four water samples from the BSL Mine were monitored and the results are in the table 4.3.

Turbidity

All samples collected have more turbidity than that of the standard. This indicates that though the sources may or may not be directly contaminated by the mining operation but are affected by it and so have high turbidity.

Conductivity

The conductivity of all the samples is within the range of the standards.

Total Suspended Solids and Total Dissolved Solids

Total suspended solids and total dissolved solids are compared to maximum values in the effluent of the same as provided in schedule vi of Environment (protection) rule, 1986 (EP, 1986) and maximum permissible limit of BIS. From figure 4.3 and 4.4 it is quite clear that all the samples have total suspended and total dissolved solids within the range of standards.

Dissolved Oxygen and Chemical Oxygen Demand

The dissolved oxygen in the water is greater than then it needed in the water .Figure 4.7 shows the Chemical Oxygen Demand of the different water samples and compares them with the standard value. It is evident from the figure that all of the water samples have less COD than the maximum value. Which implies all samples are deficient in organic matter or not equivalent to organic matter that can be oxidized by strong agents.

pH and Alkalinity

All the pH values within the upper and the lower limit prescribed. All the water samples are little basic in the nature. And the alkalinity of the samples also within the range of Indian standards.

Chloride, Nitrate and Sulphate

All the three parameters are within the permissible limits.

Hardness

Total hardness, Calcium hardness and magnesium hardness of different samples was analyzed. The total hardness is within the range but the calcium and magnesium hardness of all the samples is greater than the value of the permissible limit. By which it can interpreted that water is moderate hard.

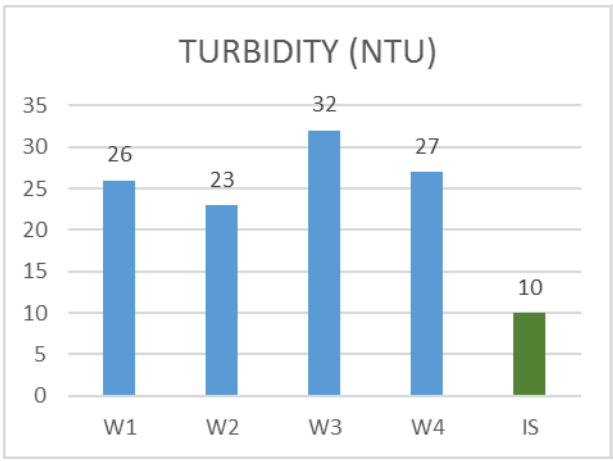

Figure 4.1 Turbidity of water samples

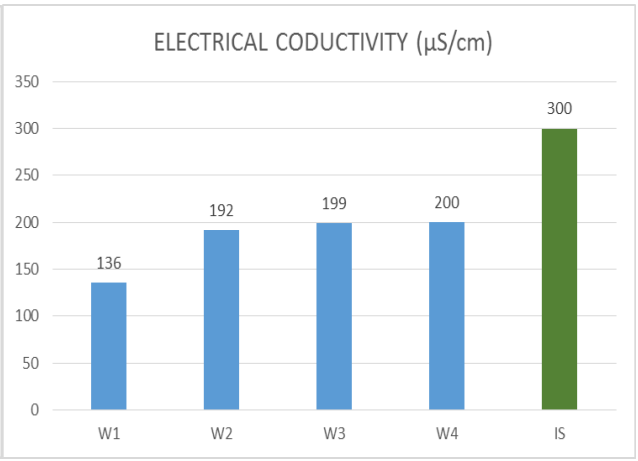

Figure 4.2 Conductivity of water samples

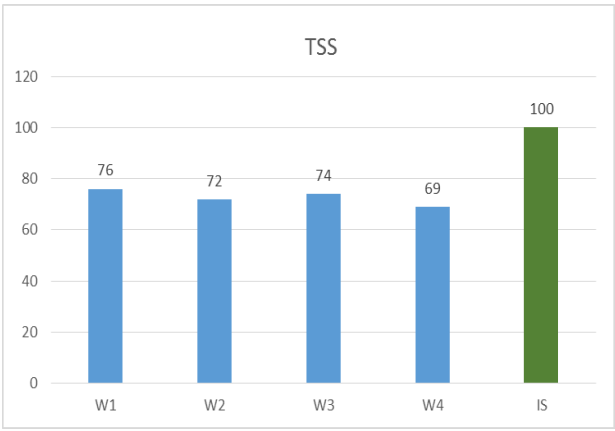

Figure 4.3 TSS of water samples

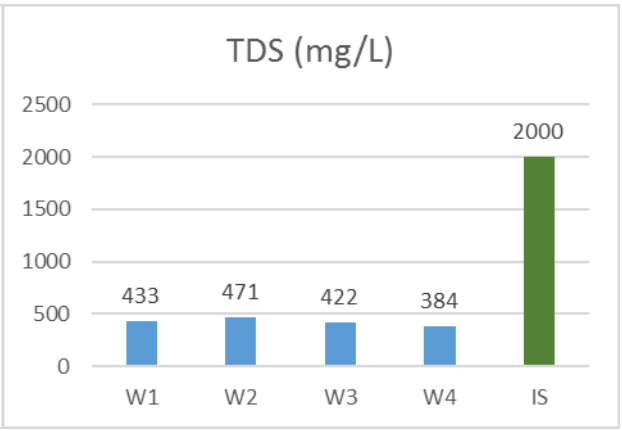

Figure 4.4 TDS of water samples

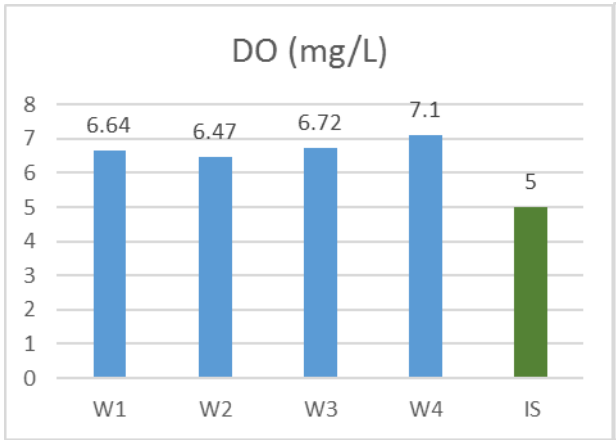

Figure 4.5 DO of water samples.

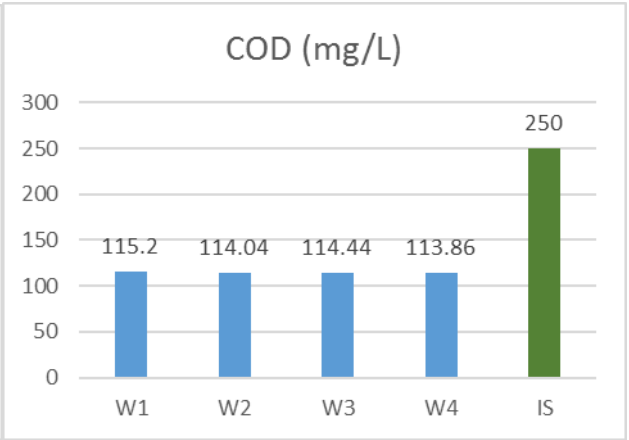

Figure 4.6 COD of water samples

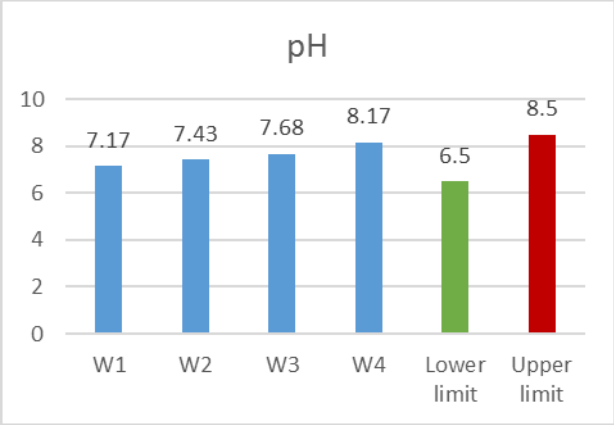

Figure 4.7 pH content of water samples

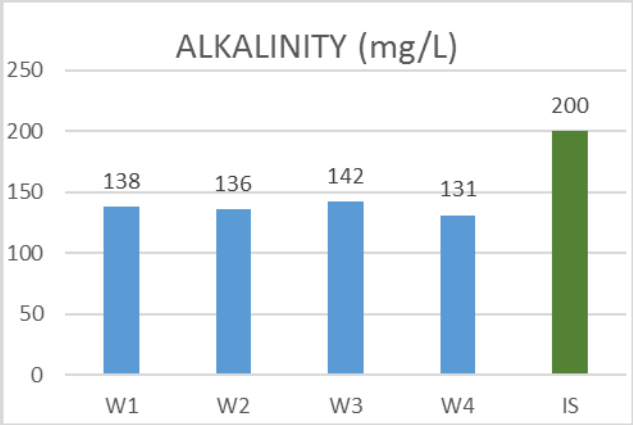

Figure 4.8 Alkalinity of water samples

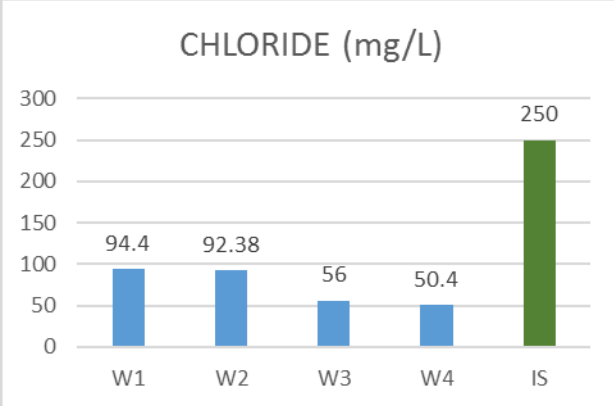

Figure 4.9 Chloride content of water samples

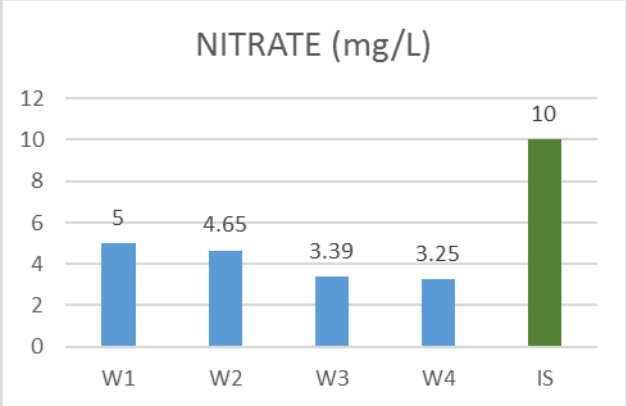

Figure 4.10 Nitrate content of water samples

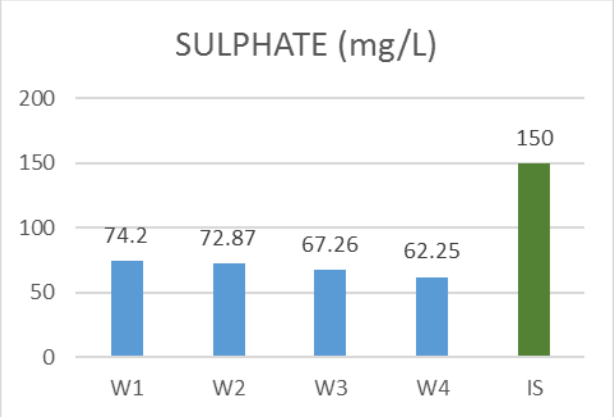

Figure 4.11 Sulphate content of water samples

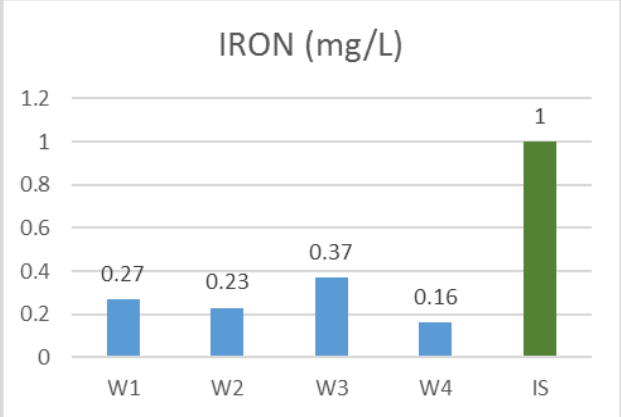

Figure 4.13 Iron content of water samples

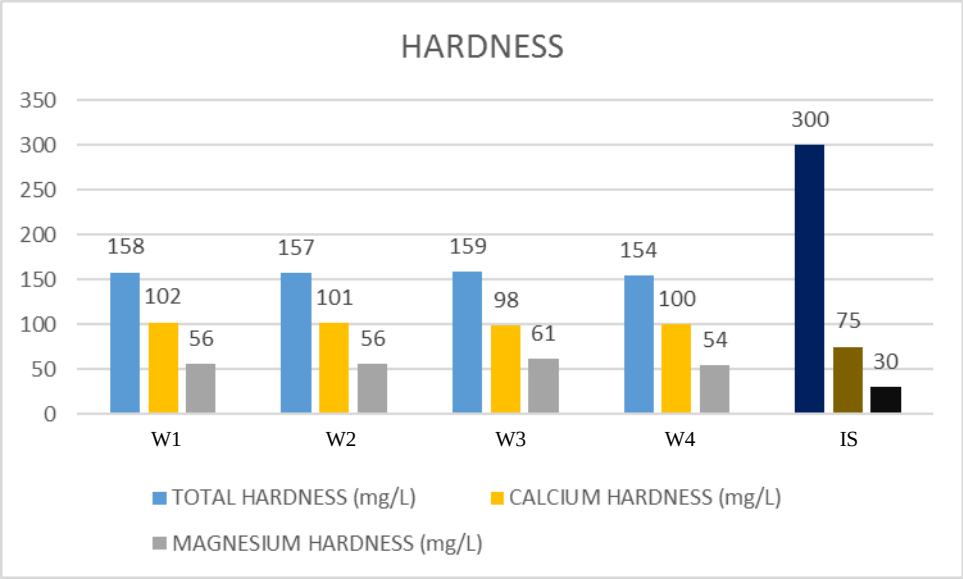

Figure 4.12 Total, Calcium and Magnesium Hardness of different water samples

CHAPTER: 5

CONCLUSION

CHAPTER: 5

CONCLUSION

The soil samples from Bolani iron ore mines was analyzed and compared to the maximum permissible limit. Most of the parameters in the samples either very less or very high as per the standards. The pH of the soil was analyzed and found that remaining all soil samples are slightly acidic in nature but the samples S1 and S5 is highly acidic in nature. The Organic Carbon of soil except the sample S8 all other samples have low value of organic carbon only the sample S8 has a satisfactory quantity. Nitrogen quantity in the soil samples S3, S4 and S7 is at medium level but in all other samples it is low.

The ratio of calcium and magnesium in the soil samples S2 and S6 is good but all other have a low calcium magnesium ratio. The sulphur quantity in all the samples except S7 have a lower value of sulphur than the prescribed value. So after saw the results of soil quality monitoring we can say that the soil quality around the open cast mines is degraded day by day due to the mining activity so we should to take some steps for save the quality of soil.

All the water samples were analyzed and found that the quality of the water is good only some of the parameters like turbidity (23-32 NTU) and calcium (98-102 mg/L) and magnesium hardness (54-61 mg/L) is slightly greater than the permissible value. So it is not harmful to the human body. Hence all the parameters of soil and water are compared, the soil is more polluted than water. So for control the soil and water pollution it is suggested that appropriate steps must be taken by the industry, State Pollution Control Board and the Government to prevent pollution of soil and water. Implementation of preventive measures proposed can be helpful to a great extent.

CHAPTER: 6

REFERENCES

CHAPTER: 6

REFERENCES

1. Pandey, G.N and Carney, G.C (1995). Environmental Engineering, Tata McGraw-Hill, 6th Edition, New Delhi, pp. 252-271.
2. Holder, J., (2004), Environmental Assessment: The Regulation of Decision Making, Oxford University Press, New York; For a comparative discussion of the elements of various domestic EIA systems, see Christopher Wood Environmental Impact Assessment: A Comparative Review.
3. Jay, S., Jones, C., Slinn, P. and Wood, C., (2007), Environmental Impact Assessment: Retrospect and Prospect, Environmental Impact Assessment Review 27, pp.287-300
4. Lenzen M., Murray, S., Korte, B., Dey, C., 2003, Environmental Impact Assessment Including Indirect Effects – A case study using input-output analysis, Environmental Impact Assessment Review, 23, pp. 263-282
5. Shepherd. A., Ortolano L., (1996), Strategic Environmental Assessment for Sustainable Uurban Development, Environmental Impact Assessment Review, 16, pp. 321-335
6. Abrahim G.M.S. and Parker R.J., (2008), "Assessment of Heavy Metal Enrichment Factors and The Degree of Contamination in Marine Sediments from Tamaki Estuary, Auckland, New Zealand", Environ Monit Assess 136, Springer Science, Pp- 227-238.
7. American Public Health Association (APHA),1985, Standards Methods for Examination of Water and Wastewater, 16th Edition, United States of America, Baltimore, Maryland.
8. Bhuiyan Md. A.H., Islam M.A., Dampare S.D., Parvez L and Suzuki S.(2010), Evaluation of Hazardous Metal Pollution in Irrigation and Drinking Water Systems in The Vicinity of a Coal Mine Area of North-Western Bangladesh, Journal of Hazardous Materials 179, Elsevier, pp-1065–1077.
9. Backman B., Bodis D., Lahermo P., Rapant S., Tarvainen T., (1997), Application of A Groundwater Contamination Index in Finland and Slovakia", Environmental Geology, 36, Pp.55–64
10. Chen A. (2007), Well Water Contaminated by Acidic Mine Water from the Dabaoshan Mine, South China: Chemistry and Toxicity, Chemosphere 70, Elsevier, pp-248–255.
11. Roy, M. P., Roy, S. K. and Singh, Dr. P. K., (2003) Impact of Mining on Environment – An Appraisal, The Indian Mining and Engineering Journal, Volume 42, pp. 11-12.

12. Lambert D.C., McDonough K. and Dzombak D.A. (2004), Long-term Changes In Quality of Discharge Water from Abandoned Underground Coal Mines in Uniontown Syncline, Fayette County, PA, USA, Water Research 38, Elsevier, pp.- 277–288.
13. Ghose M K, (1989), "Land Reclamation and Protection of Environment from The Effect of Coal Mining Operation. Mine tech", 10 (5), pp-35-39.
14. James, D.W., R.J. Hanks, and J.J. Jurinak. (1982). "Modern Irrigated Soils". John Wiley & Sons, New York, pp. 283-250
15. Pierzynski, G.M., J.T. Sims, and G.F. Vance. (1994). "Soils and Environmental Quality". Lewis Publ., Boca Raton, FL, pp. 50-59